The pricing of transport infrastructure in Europe – the theory and its application to roads and railways

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The efficient pricing of infrastructures as well as the internalisation of the external costs of transport have been key aspects of the European Transport Policy during the last fifteen years. This way the European Parliament and Commission aim to ensure that the transport pricing policy mirrors the social costs associated to its use. This article analyses the state of the matter that the European Policy of the Pricing of Transport Infrastructure and the setting of prices as a means to internalise the external costs of the rail systems and roads, and we are able to witness specific cases in the European sphere. The European Commission's renewal of its Policy of Common Transport is currently pending, of which the setting of transport pricing is an essential component.

Azpiegituren tarifikazio eraginkorra eta garraioaren kanpoko kostuak barneratzea Europako garraio-politikaren funtsezko alderdiak izan dira azken hamabost urteetan. Horrela bada, Europako Parlamentua eta Europako Batzordea ausarki ari dira saiatzen garraioaren prezio-politikak horren erabilerari lotutako gizarte-kostuak isla ditzan. Artikulu honetan garraio-azpiegiturak tarifikatzeko eta prezioak ezartzeko Euro ako politikaren gaiaren egoera aztertzen du, trenbide- eta bide-sistemen kanpoko kostuak barneratzeko tresna gisa, eta Europako eremuko adibide zehatzak aurkeztu dira. Gaur egun Europako Batzordeak bere Garraio Politika Bateratua berritzearen zain daude, garraio-prezioak ezartzeko modua funtsezko osagaia baita bertan.

La tarificación eficiente de infraestructuras así como la internalización de costes externos del transporte han sido aspectos claves de la política europea de transportes durante los últimos quince años. Así, desde el Parlamento Europeo y desde la Comisión europea se han venido haciendo continuos intentos para que la política de precios del transporte refleje todos los costes sociales asociados al uso del mismo. Este artículo analiza el estado de la cuestión de la política europea de tarificación de infraestructuras de transporte y analiza el potencial de la política de fijación de precios como medio para internalizar los costes externos de los sistemas ferroviarios y viales, y se presentan ejemplos concretos en el ámbito europeo. Actualmente se esté en espera de que la Comisión Europea renueve su Política Común de Transportes, donde la fijación de precios del transporte es un componente clave en la serie preliminar de objetivos. Por ello la política tarifaria del transporte se considera un asunto de máximo interés.

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1. **INTRODUCTION**

Efficient pricing in transport and the internalisation of the external costs of transport have been key aspects of European transport policy now for some 15 years. Starting with the Commission's Green Paper 'Towards Fair and Efficient Pricing in Transport' (CEC 1995), and continuing with the White Paper 'Fair Payment for Infrastructure Use' (CEC,1998) and the Common Transport Policy White Paper (CEC,2001), there was a strong emphasis on pricing policy to reflect the full social costs of transport use. Then, in 2006, so-called 'smart charging' formed a key plank of the Commission's re-statement of its Common Transport Policy which followed their mid-term review of policy goals and progress (CEC, 2006b). Also in 2006, as part of the revision of the Eurovignette directive, the European Parliament asked the Commission to present (by June 2008) "a generally applicable, transparent and comprehensible model for the assessment of all external costs to serve as the basis for future calculations of infrastructure charges". They furthermore asked that "this model shall be accompanied by an impact analysis of the internalisation of external costs for all modes of transport and a strategy for a stepwise implementation of the model for all modes of transport" (CEC, 2006a).

In 2008, as their response to the European Parliament's request for a model for the assessment of all external costs, the Commission published its communication

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on Greening Transport (CEC, 2008). The intention was that this would provide a general framework of reference for the internalisation of external costs in the transport sector. Most recently the policy of Smart Charging to internalise the external costs of transport is restated in the Commission's Communication, A Sustainable Future for Transport (CEC, 2009), which serves as a discussion document for its common transport policy beyond 2010.

Accompanying the interest in transport pricing brought about by the Commission's moves on the policy front there has been a considerable body of research in the area over the past decade – much of which has been funded by the European Commission. This research has focused on two general areas central to the pursuit of the Commission's transport pricing policy:

— estimation of the external costs of transport (much of which is drawn together in the Commission's Handbook on the estimation of external costs in the transport sector (CE Delft, 2008a)); and

— Understanding the potential impacts of different pricing policy options on the economy, on the environment and on society at large.

More recently, research efforts have focused on the question of how to implement the policy, as well as on resolving the remaining uncertainties emerging from the research on measurement and impacts. In addition to this research, considerable effort has been put into communicating the policy, disseminating research findings and building consensus amongst stakeholders.

This paper examines the state of the art and the state of practice regarding the pricing of transport infrastructure. It focuses on the potential for pricing as a means of internalising the external costs associated with road and rail systems, drawing on particular examples from throughout Europe. On the eve of the European Commission renewing its Common Transport Policy, with transport pricing featuring as a core component of the draft set of objectives, it appears that European transport pricing policy is at an exciting juncture.

2. THE THEORY AND ITS APPLICATION IN EUROPEAN TRANSPORT POLICY

Conventionally, economic theory defines social costs as being the full costs to society associated with engaging in a particular economic activity. Social costs are said to be comprised of:

— private costs – those costs arising out of an individual engaging in a particular economic activity that directly accrue to an individual and hence, feature in their individual decisions regarding that economic activity; and

— external costs – those costs arising out of an individual engaging in a particular economic activity that accrue elsewhere in society and, hence, would generally be 'external' to an individual's decision regarding that economic activity.

It is argued that it is the mis-match between the full social costs imposed by the use of transport and the partial, private costs faced by the individual in their decision-making process that lies at the heart of many of our current transport problems.

The social costs of transport infrastructure use are imposed both within the transport system and elsewhere in the economy. When a vehicle enters the transport system it will generally impose some incremental damage on the infrastructure, consume additional system capacity (and, hence, contribute to congestion and delays), emit fumes which contribute to local air pollution and to global warming, generate noise (be that from its engine and/or from the rub of its wheels on the road or track) and contribute in some way to the risk of a transport-related accident occurring. Yet, when individuals make decisions about whether, when, where and how to travel they do so based on the additional cost to themselves; i.e. the marginal private cost, which might be viewed as being a subset of these costs; principally enshrined in vehicle purchase and operating costs, fuel costs, ticket prices and their assessment of their time costs and of the relative merits of different means of transport.

Problems that impact directly on the transport system primarily include deteriorating infrastructure quality and increasingly congested infrastructure - particularly at certain times and places - resulting in journey-time delays and unreliability, over-crowding and scheduling problems. For example, it is estimated that, in Europe, costs associated with road congestion – roads being the most congested of the transport modes - amount to 70 billion Euro, approximately 1% of its overall GDP (Nash, 2003).

In addition to these problems facing the transport system and which have direct effects on transport-related activities, the transport system is a source of problems which have wider impacts for the economy, the environment and the wider society. Environmental pollution and external accident costs of road transport, - roads again being the most polluting and most dangerous of the transport modes - taken together, were found to be 122 Billion Euro, approximately 1.6% of Europe's GDP (Nash, 2003). These problems, resulting from the failure to reflect the costs imposed by users of the transport system in their individual travel decisions, have the effect of imposing costs on others engaged in travel, on governments who intervene in an effort to alleviate these problems and on the whole of society.

In recent years, the policy response to these problems has increasingly been to place greater weight on the use of economic instruments, based on economic theory concerned with the 'internalisation of external cost. That is, providing transport users with pricing signals related to the marginal external costs of their transport use which they can incorporate into their decision-making process, alongside their assessment of the marginal private costs of transport use. The aim is, thus, to provide appropriate incentives for the efficient use of the transport system.

The theory provides, at first glance, some clear principles that might be applied in order to internalise the external costs of transport, and the European Commission's policy since 1995 has centred on these principles and on exploring how they might best be implemented. Essentially this approach is that known to economists as short run marginal social cost pricing, whereby prices are set to reflect marginal external costs (that is, the additional costs to society associated with an additional km travelled or an additional trip made, given that the capacity of the transport network is held constant). If monetary values can be

placed upon externalities then they can be incorporated into the pricing mechanism by means of direct charges or subsidies; in this way they will then be taken into account by all economic agents.

Prices which reflect the additional infrastructure and external costs will act as signals to travellers about the 'social' costs associated with their additional travel. They will then base their demand decisions – whether, where, when, how and how far to travel - upon these price signals. In fact, prices fulfil several functions in parallel. In addition to acting as cost signals, the price mechanism is the best way to ensure that a limited supply of a good is made accessible to those who value it most. By raising prices until the total demand equals the available quantity, the consumers with the highest willingness to pay for the good receive the good. Also, in competitive markets firms will only succeed if their prices are kept as low as possible; otherwise their competitors will take their markets. In this way the price mechanism provides all producers with incentives to develop cost-reducing production techniques.

Three components of cost, associated with the addition of extra traffic to the existing infrastructure, must be measured for the principle of short run marginal social cost pricing to be taken forward in the context of transport infrastructure. The first is the cost imposed by additional use on the infrastructure provider. This comprises additional maintenance and renewals costs plus any additional operating costs. The second component is the marginal cost imposed on other infrastructure users, in terms of delays, congestion, accidents and opportunity costs (perhaps more commonly referred to as scarcity costs), on those modes where there is a physical limit and once all the slots are taken no-one else can get one. The third element is the cost imposed outside the transport system and that is mainly environmental cost, but some elements of other costs such as accidents, for instance where these are borne in part by the police or health service and not recovered from users.

The same sort of approach may be taken to scheduled transport services. In the case of private transport, if the infrastructure prices are right, essentially, the problem of efficient use of the system is solved. But with scheduled public transport services and with freight transport services that is not so. Or at least it is not so unless there is a fully competitive environment so that it can be left up to the market to determine what is produced. In practice, this is rarely the case, and there are various cost characteristics - of scheduled transport in particular - which make that difficult and unlikely. For instance when traffic is added to public transport systems, either this raises load factors or leads to operation of larger vehicles or longer trains, in which case the marginal cost to the operators is very low, or services are increased, in which case there is a benefit to existing users from a better service as traffic rises. In other words, for the marginal social cost of operating scheduled transport services, there is again a mix of costs to the supplier, to the users and to society at large. But the cost to other users is typically negative because extra traffic leads to an improvement in the service (Mohring, 1972). This means that there is very often an *a priori* case for subsidising scheduled transport services in order to implement pricing policies which do not cover full cost. In the absence of efficient provision of the scheduled transport

services themselves there is no guarantee that simply getting the infrastructure pricing right will even improve resource allocation let alone solve the problem. The Commission has been concerned mainly with infrastructure pricing because of its concern with the terms of competition between different users of the infrastructure as it promotes open access and competitive markets for all modes of transport, but in doing so it has given less attention to a very important aspect of transport pricing, which is that for scheduled transport services it is the final price to the consumer that determines its competitive position with respect to other modes.

There are, however, numerous reasons why the simple 'textbook' approach to marginal cost pricing, as applied to transport, may not be optimal in practice. These reasons are comprehensively identified by Rothengatter (2003), but may be summarised as follows:

(a) measurement is complex;

(b) equity is ignored;

(c) dynamic effects, including investment decisions and technology choice, are ignored;

(d) financing issues are ignored;

(e) institutional issues are ignored;

(f) price distortions elsewhere in the economy are ignored;

(g) the administrative costs associated with implementation may not always be justified by the benefits.

All of these criticisms are well established in the literature and are, in a sense, undeniable. For some, the conclusion is that they render a policy based on the application of marginal social cost pricing unimplementable, whilst for others – the author included – they simply represent a series of issues that must be taken into account when taking forward the implementation of the theory.

For instance, it is undeniable that measurement of short run marginal social cost is complex. The nature of most external costs is that they are situation-specific. That is, the external cost associated with a particular vehicle, on a particular piece of infrastructure, in a particular place at a particular time is likely to be specific to that set of circumstances. The same vehicle, on the same infrastructure, in the same place but at a different time is likely to give rise to a different level of external cost. Similarly, the same vehicle at the same time, in the same place but on a different piece of infrastructure is again likely to give rise to a different level of external cost. This makes the accurate estimation of external cost a very case-specific task. In theory, a policy to internalise external costs throughout Europe would require cost estimates to be derived for every set of circumstances that exists throughout Europe, but a proposal to undertake such an enormous exercise would almost certainly lead policy-makers to abandon the policy itself. Instead, it is likely to be more fruitful to undertake case-specific cost estimation exercises wherever possible, and then to use those estimates to form an understanding of the ways in which costs vary from one set of circumstances to another. With this understanding, it should become possible to make reasonable approximations of costs in circumstances where detailed cost estimates are not available and where it is not possible, for whatever reason, for them to be undertaken.

For example, the well-known relationship between average cost and marginal cost, known as the cost elasticity with respect to traffic output, has been utilized as a means of estimating marginal costs.

$$Cost\ Elasticity = \frac{Marginal\ Cost}{Average\ Cost};$$

and hence

$$Marginal\ Cost = \frac{Cost}{Elasticity} * Average\ Cost$$

Lindberg (2006) reports on a number of case studies using econometric methods to estimate this elasticity using data for a number of countries. In all cases data on maintenance cost was available at the necessary level of disaggregation; appropriate data on renewals and operations was more scarce. The roads case studies found that the elasticity for road infrastructure cost decreases as the measure changes from renewal to maintenance and to operation. The average elasticity for maintenance and renewal cost is between 0.5 and 0.7, while the elasticity for operations cost appears to be more or less zero. The rail case studies found that elasticity for rail infrastructure cost is lower than the elasticity for road and less variable between different measures. The average elasticity is between 0.26 and 0.30 for an aggregate of renewal and maintenance costs, for maintenance costs it is between 0.20 and 0.24 and for operation or short term maintenance costs it is 0.29 to 0.32. Thus, ignoring other externalities, efficient prices would be somewhat below average costs for roads and a long way below for rail.

Scarcity costs, which arise on those modes where use of the infrastructure is scheduled and the presence of operators filling all the slots make it impossible for anyone else to get access to the infrastructure at the time in question, are little researched. Whilst enormous progress has been made on the measurement and valuation of environmental costs and external accident costs these too are of course still subject to big uncertainties. However, Lindberg (2006) concluded that research within a number of European projects is rapidly reducing this uncertainty, and that 'the use of proper theory and modern methods will lead to a convergence also of the more difficult marginal cost categories in the near future'.

In other words there is no reason for measurement problems to hold up moves towards marginal social cost pricing. In any event it is hard to argue that, were marginal social cost the right concept to use in pricing, measuring something else instead of using the best estimate possible would be a sensible approach.

So whilst it is important to take into account the range of factors which mitigate against the full implementation of 'pure' short run marginal social cost pricing, such as those identified by Rothengatter (2003) and summarised above, it does not mean that a totally different theoretical approach to pricing policy needs to be adopted. Nash and Matthews (2005) provide a detailed discussion of each of the points a-g identified above. In essence, it is argued that it is increasingly possible to measure marginal social cost and to move towards it as the basis of transport pricing although difficulties and uncertainties remain. Considerations such as budget constraints, equity, institutional issues, simplicity and price distortions elsewhere in the economy lead to a need to depart from pure marginal social cost pricing but do not change the position that the measurement of marginal

social cost is the correct starting point in the development of any efficient pricing policy. For this reason, the phrase 'marginal social cost based pricing' rather than 'marginal social cost pricing' has entered the lexicon, to summarise the philosophy being adopted (Verhoef, 2001).

Probably the most explicit and co-ordinated expression of this theory within the policy arena has been via the European Commission, in the development and implementation of its transport pricing policy over the past 15 years. Outside of the EU, however, pricing is also becoming a prominent feature of transport policy, in particular for roads, with the most notable developments having occurred in:

— Singapore, where there has been a system of road pricing since 1975;

— Norway where several urban road pricing schemes have been introduced since 1986;

— the USA where several road pricing schemes have been introduced as part of the Value Pricing Programme; and

— Switzerland where a heavy vehicle fee was introduced in 2001.

The major shift in transport pricing policy development at the European level came in 1995, with the publication by the European Commission of its green paper "Towards fair and efficient pricing in transport" (CEC, 1995). Whereas previous discussion of EC pricing policy had emphasised maintenance and operating costs, this paper recognised the importance of pricing to reflect external costs. It clearly proposed the basic principles of marginal social cost pricing as constituting the bedrock of European transport pricing policy.

The Commission subsequently set out its strategy for pursuing those principles in a White Paper entitled 'Fair Payment for Infrastructure Use'. The core features of the White Paper focused on the need to relate prices more closely to the underlying marginal social costs associated with infrastructure use, extending these costs to include external costs, and with the need to depart from prices that are purely based on the direct costs of infrastructure use when cost coverage requirements need to be met. The need to ensure transparency, and to facilitate fair competition between modes, within modes, and across user types was emphasised. Furthermore, the contribution of transport services to the enhancement of industrial efficiency and European competitiveness was recognised.

In order to give transport users and providers time to adjust, the White Paper proposed a phased approach to the implementation of this framework. The first of three phases, identified as running from 1998 to 2000, aimed to ensure that a "broadly compatible structure is in place in the main modes of transport" (CEC, 1998). Air and rail were to be the particular focus of this first phase and prices incorporating external costs, on the basis of an agreed Community framework, were to be allowed but total pricing levels were to be capped by average infrastructure costs. The second phase, identified as running from 2001 to 2004, aimed to oversee further harmonisation. The White Paper proposed that this phase would particularly focus on rail and heavy goods vehicles, where it was proposed to institute a kilometre based pricing system differentiated on the basis of vehicle and geographical characteristics, and on ports, where it was proposed to introduce a pricing framework. From here on in, it was

proposed that prices should be capped at marginal social cost. The third and final phase, identified as running from 2004 onwards, should revisit the overall pricing framework, with a view to updating it in light of experience.

The principle of subsidiarity, which recognises that the location-specific nature of many transport externalities means that policy action is often better pursued at the national or local, rather than the European, level, was affirmed by the Green Paper on fair and efficient pricing. This has meant that European policy development has focused much less on urban transport than on inter-urban transport. However, the Green Paper did highlight the possible need for European involvement in local issues where they affected the efficient workings of the internal market. The White paper (CEC, 1998) went on to commit to encouraging member states to develop urban road pricing systems and to reviewing any Community legislation that may harm implementation. In furtherance of its plan to encourage member states to develop urban road pricing, the Commission has supported and facilitated a number of cross-national networks of interested cities (e.g. EUROPRICE and PROGRESS).

The Commission's 2001 Transport Policy White Paper (CEC, 2001) reaffirmed the commitment to more efficient pricing of transport in order to internalise externalities, and proposed a framework directive on pricing which would set out the principles to be followed in all modes of transport. It also acknowledged the important link between pricing and financing, with proposals to permit funds raised from some sectors of the industry to be used for worthwhile projects in other sectors where the result is to reduce social costs.

In the event, the proposals contained in these early policy documents were shown to be extremely optimistic. In particular, the progress through the different phases identified in the 1998 White Paper has proved much more difficult and slow than was envisaged, and the scale and complexity of the process associated with progressing the 2001 White Paper's proposal for a Framework directive led to that being shelved in 2003.

The Commission's 2006 mid term review of its Transport White Paper policies (CEC, 2006b) sought to inject new impetus and involved some rephrasing of its priorities. It spoke of 'co-modality' and 'smart infrastructure charges', rather than shifting the balance between modes and internalising externalities. Co-modality was explained as ensuring that each mode could perform that function in the transport market for which it was most efficient. This was interpreted by some as a complete change of policy. However, it is clear that each mode can only play its most efficient role if appropriate pricing and investment policies are in place, so co-modality is entirely consistent with, and even dependent upon efficient pricing policies. In fact, the Communication forming part of the 2008 Greening Transport package (CEC, 2008) contains a firm restatement of the commitment to the internalising of externalities in the form of marginal social cost pricing.

Most recently, the Commission's Communication on a Sustainable Future for Transport (CEC, 2009), which forms the starting point for the renewal of its Common transport policy from 2010 onward, contains several references to the need for further development of European transport pricing policy. Identifying climate change, the future price of oil and current and

ongoing congestion as three of the most urgent problems facing the sector, it sets out the key priorities as being "better integration of the different modes of transport as a way to improve the overall efficiency of the system and the acceleration of the development and deployment of innovative technologies — within an approach that always keeps the transport users and workers, with their needs and rights, at the centre of policymaking" (CEC, 2009). These priorities are disaggregated into a series of 7 broad policy objectives, including "Smart Prices as Traffic Signals'. Referring directly to the internalisation of the external costs of transport, it states "Transport operators and citizens are not always in a position to identify among several transport alternatives what is best for the economy and the environment, but with correct pricing of externalities for all modes and means of transport they would make the right choice just by opting for the cheaper solution" (CEC, 2009).

3. **ROADS**

European policy specifically regarding infrastructure pricing for road transport largely concerns road freight traffic; the issue of pricing for the use of roads by the private car being an issue where subsidiarity is seen to apply. Policy was initially, in the mid-1990s, aimed at limiting competitive problems within the road freight sector caused by the existence of very different methods and levels of pricing for infrastructure use in different countries. For example, vehicles licensed in a country with low annual licence duty plus supplementary tolls may have an unfair competitive advantage when competing with a vehicle licensed in a country with high licence duty and no supplementary tolls. In 1999, Directive 99/62/EC (European Parliament, 1999) served as a response to these concerns, and established a common EU supplementary license, known as the Eurovignette. The Eurovignette was intended to set a limit for the maximum infrastructure access prices payable as a general supplementary licence for heavy goods vehicles, on the basis of average infrastructure costs, with non-discrimination between goods vehicle operators of different nationalities.

Directive 2006/38/EC, revises the Eurovignette regime and represents current European road goods vehicle pricing policy. When this directive was finalised, in March 2006, it was stated that it would 'encourage member states to introduce and develop tolls and charges which will make it possible to improve the management of commercial freight traffic, reduce pollution and generate funds for investment in new infrastructure.' (CEC, 2006a).

The 2006 Directive allows the toll to be applied to all HGVs (vehicles weighing over 3.5 tonnes) as from 2012, replacing the 12 tonnes limit applicable until then. It is applied to the trans- European network (TEN) but permits application of pricing to other roads as well. It is also recommended that 'revenues from tolls or user charges should be used for the maintenance of the infrastructure concerned and for the transport sector as a whole, in the interest of the balanced and sustainable development of transport networks.' (European Parliament, 2006).

In terms of differentiation, the 2006 Directive provides for variations according to a number of factors such as:

— the distance travelled;

— infrastructure type and location as expenditure on maintenance on a trunk road varies from that on a motorway, and infrastructure type and location also influence accident rates and the cost of noise and air pollution;

— the vehicle type which includes characteristics such as axle weight and suspension type which influence infrastructure repairs and maintenance. Engine type, energy source and emission standards influence air pollution levels and vehicle size as larger vehicles make a bigger contribution to congestion;

— the time of day, which also affects congestion levels as it varies from peak and off-peak times.

Furthermore, the 2006 Directive allows member states the ability to increase tolls with a 'mark-up' (they can charge up to 15% more or 25% on cross border routes) on roads in particularly sensitive mountainous areas. The income from the mark-ups must then be used to optimise the transport system, which can include paying for infrastructure on alternative modes such as rail.

Whilst the 2006 Directive allows an increased degree of variation in tolls to reflect congestion and a range of cost drivers, it is actually not properly consistent with the policy of short run marginal cost pricing adopted by the European Commission in the White Paper on Fair Charges for transport infrastructure (CEC, 1998) and reaffirmed since. Firstly, the degree of differentiation is heavily constrained by a requirement that no charge be more than 100% higher than the minimum. Secondly, as in the earlier Directive, on average, user charges are tied to the costs of construction, operation, maintenance and development of the network. The overall average charge is to be equal to average infrastructure costs, where infrastructure costs must be allocated to vehicle types on the basis of equivalence factors based on objective evidence. This linking of average user prices to the cost of "constructing, operating, maintaining and developing the network" further limits the extent to which the overall level of tolls can reflect environmental costs, external accident costs and marginal costs of congestion. There would obviously be a degree of double counting if both additional capacity and congestion costs were charged for, whilst the exclusion of environmental costs from the total costs to be covered was explained by the Commission on the grounds that these are more uncertain than infrastructure and external accident costs, despite the enormous amount of work the Commission has funded on their measurement and valuation in recent years. Additional regulatory charges to deal with congestion and environmental problems are permitted, but only in specific circumstances.

Part of the compromise agreed upon in 2006 was that the European Commission be required to re-examine the issue of external cost and produce new proposals within 2 years, and it did this as part of the Communication on the Greening Transport Package (CEC, 2008). In this, the Commission proposes to allow prices to reflect congestion, local air pollution and noise. However, congestion costs may only be incorporated into pricing to the extent that congestion costs exceed long run allocated infrastructure costs. In that sense, the base price is equivalent to long run

marginal cost, with the short run marginal cost of congestion acting as a cap. Furthermore, the new proposals do not permit pricing for external accident costs, as it is argued that these should be internalised via the insurance system. This, however, is not currently possible and there is no indication of any mechanism by which this situation might change.

The 2008 proposals do not seek to incorporate the costs of climate change into the pricing framework, as it is argued that these are better charged for through fuel tax. It was also argued that, by addressing congestion, fuel consumption would be reduced, thereby indirectly leading to a reduction of CO2 emissions. The EU legal minimum level of fuel tax is 30.2 eurocents per litre for diesel which, if we assume that all other components of external cost are covered by other prices, would cover a shadow price of CO2 well in excess of 85 euros per tonne of CO2; higher than most studies suggest (CE Delft, 2008b). Of course, in the current situation other components of external cost are not covered by other prices in most countries, and therefore road haulage remains cheap, resulting in excessive CO2 emissions as well as other external costs. Recent work to advise the Commission on the development of its policy – in support of the Communication on Greening Transport - strongly argued that both the information and the methods now exist to correct this distortion (CE Delft, 2008b).

As part of that work to advise the Commission, a handbook on the measurement of external cost, drawing together much of the recent research on this topic, has been developed on behalf of the Commission (CE Delft, 2008a). This set out estimation methods and example values for the range of external costs, and the 2008 proposals prescribe the use of this handbook for the purposes of calculating prices relating to external costs. The proposals lay down maximum permissible prices, approximately equal to the average in the handbook. The justification for regulating prices is to prevent countries in strategic locations from imposing excessive prices in order to make money out of transit traffic, but the result of such caps is to prevent full internalisation of externalities in circumstances in which external costs are above average.

It is not proposed that this differentiated system be compulsory. The European Commission's argument is that incorporating external costs into prices is worth doing where there are serious problems of external cost, but that it is not worth pursuing where traffic is relatively light. However, varying the km based price with the characteristics of the vehicle and administering it via the tachograph would be a simple system and would cost little to operate. Hence, perhaps this would be worth doing everywhere and should be made compulsory. Beyond this, differentiated pricing to more specifically equate to levels of external cost, which would be more expensive to administer, should be permitted, but its implementation could be allowed to vary according to the levels of external costs experienced in different places, subject to an assessment of the costs and benefits of implementation.

Early indications are that securing agreement on the revisions to the Eurovignette Directive proposed in the 2008 Greening Transport package is not going to be easy. The proposals were discussed at the Council of Ministers in December 2008, where issues of earmarking and of congestion cost were particular stumbling

blocks in the way of ministers reaching agreement (the proposal currently under consideration seeks to earmark receipts for spending on making transport more sustainable). In March 2009, the first reading went through the European Parliament with few amendments, but the Council of Ministers failed to reach agreement.

In parallel with these developments in EU-wide transport infrastructure pricing policy, a number of EU member states have been examining proposals for national schemes for the pricing of heavy goods vehicles. Indeed, Austria in 2004 and Germany in 2005 have introduced their own distance-based road pricing systems for heavy goods vehicles using their national motorway networks. However, these are somewhat removed from the thrust of European policy with regard to the internalisation of external cost, and hence outside the scope of this paper. Instead, they are based on infrastructure capital, maintenance and operational costs and might be seen as an alternative means of roads finance, though they do incorporate some price differentiation according to environmental factors.

Whilst attention has focused on heavy goods vehicles, as private cars are seen as the responsibility of Member States, the broader perspective of prices for all road-users should not be lost. A situation where there remains a widespread lack of use-related prices for private cars, light vans, buses and coaches is one in which the terms of competition between the modes remains unequal. It is acknowledged that, in terms of the European Commission, there are subsidiarity issues here that obviate against European legislation, but the Commission could usefully continue its role as a facilitator and shaper of policy debate.

4. **RAILWAYS**

EU policy on railway infrastructure charging is enshrined in Directive 2001/14, on allocation of railway infrastructure capacity and levying of charges. In summary, the directive determines that charges must be based on 'costs directly incurred as a result of operating the train service". They may include:

1. Scarcity, although where a section of track is defined as having a scarcity problem, the infrastructure manager must examine proposals to relieve that scarcity, and undertake them unless they are shown, on the basis of cost benefit analysis, not to be worthwhile;
2. Environmental costs, but these must not lead to a rise in the average level of charge unless they are levied on other modes;
3. Recovery of the costs of specific investments where these are worthwhile and could not otherwise be funded;
4. Discounts but only where justified by costs; large operators may not use their market power to get discounts;
5. Reservation charges for scarce capacity, which must be paid whether the capacity is used or not;
6. Non discriminatory mark ups but these must not exclude segments of traffic which could cover direct cost.
7. Specific time limited subsidy schemes are permitted to offset the effects of a failure to charge appropriately on other modes.

It seems from the list of elements that may be included in the charges that 'the

direct cost of operating the service' is to be interpreted as short run marginal social cost.

In recent empirical studies of wear and tear costs it was calculated that charges based on marginal cost would cover only 20-30% of the total maintenance and renewal costs (Wheat et al, 2009). Most other costs of the infrastructure manager appear to be largely fixed, and although charges for congestion and scarcity might significantly increase cost recovery, it appears likely that pure marginal cost pricing will fall far short of covering total cost.

There is a wealth of literature relating to alternative means of recovering more than simply marginal cost. The standard economic argument would justify mark-ups above marginal cost targeted more on markets where demand is less responsive to changes in price, such that the price elasticity of demand is low, as it is in these markets that the mark-ups will have less impact on demand. However, such mark ups still give operators an incentive to cut services below what would exist with pure marginal cost pricing. The generally advocated alternative is two part tariffs, comprising a variable part equal to (or based on) marginal cost and a fixed part needed to achieve the cost recovery target. The attraction of two part tariffs is that the fixed part may be related to ability to pay, but leave the operator free to raise the necessary cash in the way that loses them the least traffic, whilst the variable part may be equal to marginal cost. The difficulty is that, if the fixed part is the result of a tariff, rather than negotiated on the basis of ability to pay, it almost inevitably favours large operators against small. This is not a problem with franchised services, provided that whoever wins the franchise pays the same fixed charge.

Whilst allowing for mark-ups above marginal cost, the Directive provides very little guidance on the application of these mark-ups. Consequently, there appears to be a great deal of variation in their use and calculation, generating a further driver of overall variation in the charges. There is no transparency about the calculation of direct costs and mark ups in most countries.

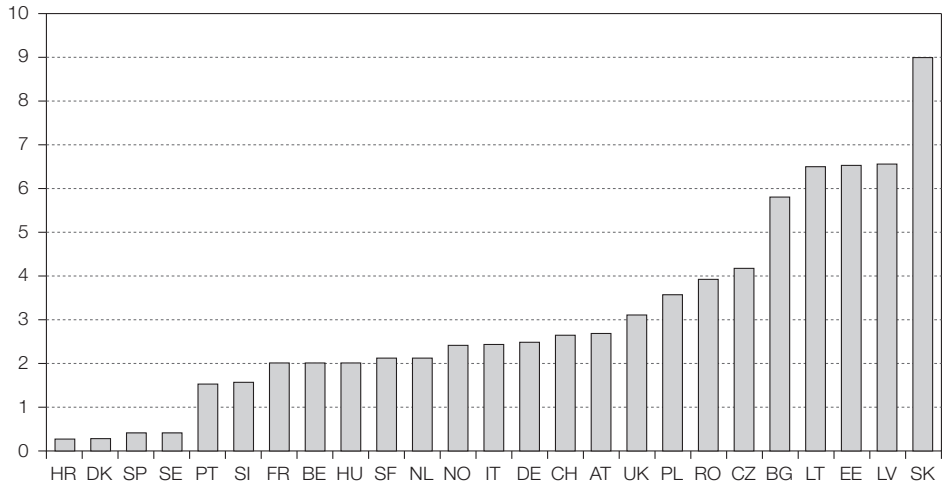
In other words, this Directive reflects some quite sophisticated argument, and includes special provisions for a range of situations. However, there is a lack of clarity about some of the provisions, whilst the flexibility it gives also may lead to a variety of approaches. In particular, the degree to which competitive charges for paths involving several countries will be achieved will inevitably be limited.

Nash et al (2005) - partly updated in ITF (2008) - shows the wide range of practices in rail infrastructure charging within Europe regarding which cost elements are covered by the charge and the form of the charge, which ranges from a simple charge per gross tonne kilometre in Finland, to a mix of reservation charges and charges per train kilometre differentiated by type of infrastructure and time of day in France. It appears that a wide range of approaches to this issue persist, which may lead to confusing and contradictory price signals for operators of international trains. But it is the level of charges in some countries which causes most concern.

Figure 1 illustrates the variety of average levels of charge found for a typical freight train. It will be seen that these vary enormously from a fraction of a euro per train km in Greece, Denmark, Spain and

Figure 1

Typical Freight Access Charges € per train-km in 2008



Source: ITF (2008).

Sweden, to over 6 Euros in Estonia, Latvia and Lithuania and 9 Euros in Slovakia. There is a clear pattern of high charges for freight traffic in Central and Eastern Europe, and there are concerns that these may even exceed the 'stand alone' cost of the necessary infrastructure for freight operations in order to subsidise infrastructure needed for passenger services. Importantly, Directive 2001/14 is vague in relation to maximum charges, and whether it is permissible for them to exceed even stand alone costs. It should be noted also that further changes to the charges have already been announced for future years, including substantial increases in France.

Typical charges for different types of passenger train exhibit as much variety as in freight, but the pattern is rather different, with some of the Central and Eastern European countries that have high freight charges having very low passenger charges which implies cross subsidies of passenger businesses by freight ones. The other point not revealed in average figures is the very high charges that may apply for new infrastructure, such as high speed lines (UIC, 2007), bridges or tunnels. These are up to 16 euros per km for the busiest high speed lines in France, and much more than that for the Channel Tunnel and the first high speed line in Britain. It is well understood that governments will want to recoup much of the cost of such projects from users and this is unproblematic if it does not greatly impact on rail market share, but there is evidence that on routes where the rail market position is less strong, high charges can damage rail market share so much as to destroy the case for the investment.

Adler, Kroes and Nash,(2008) find that the social benefits of high speed rail are much greater if marginal cost pricing is used to promote efficient mode split than if very high charges are levied, leading to poorer utilisation of new infrastructure capacity. Moreover, at low infrastructure charges, a franchised operator can afford to pay a substantial lump sum towards infrastructure costs (or as a premium for the franchise, which can then be used to help pay for the infrastructure). This is a more efficient way of achieving this result than by high variable charges which discourage provision of high levels of service. But it is highly problematic when open access entry is permitted, as it may be judged discriminatory and open access entry will in any case reduce the profitability of existing services and therefore the ability of the train operator to pay for a franchise.

Thus there is a real dilemma as to how to reconcile open access entry with recovering a high proportion of infrastructure costs from users. The same issue of course applied to the high charges for freight trains in some countries noted above. Vertical separation with open access competition makes it far more difficult to recover infrastructure costs by carefully differentiating prices to reflect willingness to pay in the final transport market; the ability of the infrastructure manager to differentiate according to willingness to pay is much less than that of the train operator who deals direct with the ultimate customer. The difficulty in reconciling open access competition, efficient infrastructure pricing and high infrastructure cost recovery is at the heart of the problem with EU rail policy in countries where governments cannot or will not make a significant contribution towards rail infrastructure costs.

Whilst there is a considerable body of experience, there is relatively little evidence on the impacts of rail infrastructure charges (Other than the study noted above). This is perhaps because there are a range of possible responses that train operators might pursue and because it is difficult to separate out the effect of charges from other factors influencing patterns of train operations. Two studies shed some light on intermodal competition in the freight sector and are particularly relevant as they show the impact of different mark ups on short run marginal social cost.

Firstly, the Leeds Freight Transport (LEFT) model is used for multimodal freight demand modelling in the UK (Johnson et al, 2007). The model tests a range of individual policies for the UK. In order to form the 'best case strategies' for road and rail, the policies are bundled into two groups to form a Pro-rail strategy and a Pro-road strategy, which are tested against a Do-nothing strategy. The results are explained in terms of the impacts for 2016.

The impacts of the policy of doubling track access charges for rail freight from the existing levels, which in Britain are essentially short run marginal cost, *(Johnson et al, 2007)* is that rail tonnes fall by 2.03% and tonne km by 4.71% in comparison to the Do-nothing scenario. The length of haul falls by 2.73% in comparison to the Do-nothing scenario. As expected, the impact on road is in the opposite direction with increases in tonnes and tonne-kms and the length of haul in comparison to the Do-minimum, but the increases are rather modest. Interestingly, introduction of marginal social cost pricing on roads, part of the pro-rail strategy, has a bigger impact, increasing rail-tonne kms by 18% (reducing road by 11%).

Secondly, the British Office of Rail Regulation (ORR) commissioned MDS Transmodal to assess the impact of an increase in track access charges on freight traffic (MDS, 2006). This work formed part of their work to review British charges, and was designed to investigate the impacts of including a mark-up on infrastructure charges for freight so as to recover the costs of freight-only lines. MDS used the GB Freight model along with models for intermodal and coal traffic, and their results found a substantially larger effect, with rail tonnes falling by 8% as a result of a 50% markup.

This modelling work provides a strong indication that where charges are markedly in excess of marginal cost, particularly in some parts of Europe where they are probably well above double marginal cost, rail traffic is being suppressed. These charges in excess of marginal cost are of particular concern given the relatively low charge levels on roads that tend to prevail. Indeed, it is noted that these modelling results suggest that road infrastructure charges are actually more important in terms of their impacts.

5. **IMPLICATIONS FOR THE ECONOMY**

One major concern leading to opposition to pricing reform has been worry that such reform will have damaging effects on the economy, particularly in peripheral regions. Essentially, the concern is closely focused on the potential secondary impacts of the projected increases in the monetary costs to transport users (car drivers, public transport passengers and freight operators) associated with increasing transport infrastructure prices aimed at combatting congestion and pollution. Indeed, it is clear that the costs to some transport users will increase – perhaps substantially – and concerns about the impact on these transport users is entirely legitimate; for instance, the questions of whether heavy goods vehicle operators would be forced out of business or would be able to pass all or part of the cost-increase on to their customers, leading to price rises elsewhere in the economy with potentially damaging effects on consumer demand and/or European competitiveness are undoubtedly important. However, in a full economic appraisal, these increased costs to transport users, would be rightly set alongside the benefits to transport users – principally in the form of reduced congestion - and the wider social benefits – principally in the form of pollution mitigation. Furthermore, account would need to be taken of what happens to the substantial revenues that would accrue from the pricing reforms, and the dynamic effects as producers and consumers change their behaviour in response to the price-changes.

Work to model and appraise the impacts of optimal prices for transport infrastructure was undertaken for the European Conference of Ministers of Transport (ECMT) and the European Commission in 2003 (ECMT, 2003). Using the TRENEN model (Proost and Van Dender, 1999), the results suggest that, taking together Britain, France and Germany, net welfare gains to society in excess of 100 billion Euros per year could be achieved (ECMT, 2003). Indeed, this figure was so substantial it was felt that it might actually lead policy-makers to propose more limited pricing reforms so as to avoid the 'embarrassment of riches' it could represent (Roy, 2002).

Several investigations have been undertaken to explore the secondary

economic impacts. The IASON project undertook an impact assessment of short run marginal social cost pricing in the road freight market throughout Europe using the SCENES model (Tavasszy, Renes and Burgess, 2004) and the valuation of externalities from UNITE. A computable general equilibrium model was used to assess regional impacts. TIPMAC again used SCENES but this time with an input-output model to examine economic impacts and computed the effects if revenues were "recycled" to reduce income tax (Kohler et al, 2008).

Both projects found that the impacts of efficient pricing on the economy in general were not great, since on average the cost of freight transport is only a small part of the final delivered price of goods. Whilst there was some reallocation between modes, changes to the sourcing of inputs and distribution systems were equally important in reducing road freight traffic. When recycling of revenues was not allowed for, there was some reduction of output and employment particularly in peripheral countries, but with efficient recycling of revenue all countries gained, although peripheral countries less than countries at the core.

Most recently, Proost et al (2008) used the TREMOVE model to analyse the impacts of three pricing scenarios each of varying complexity. TREMOV allows for the estimation of the demand reactions and modal shifts which follow on from the initial pricing reforms, for the variation of some external costs (eg, congestion) as a function of the volume of transport, and for the estimation of welfare effects depending on how the way the transport revenues are used. Furthermore, the pricing scenarios use the most recent estimates of marginal external cost generated in the GRACE project. All scenarios are based on the abolition of all existing taxes, charges and subsidies on transport and on non road modes covering their variable costs and marginal external environmental and noise cost. The three scenarios are:

— Scenario 1 - fuel taxes plus a flat rate kilometre charge for heavy goods vehicles;

— Scenario 2 - country and vehicle specific kilometre charges for all vehicles; and

— Scenario 3 – differentiation of the kilometre charge more finely in time and space.

For each of the 3 scenarios two variants are defined that help to understand the role of the use of the net change in transport revenues that result from the policy change. In most partial equilibrium models, the net change in tax revenues is added as a benefit to the changes in consumer surplus and producer surplus with a weight of 1. In TREMOVE, the value of extra tax revenue collected will depend on two factors: where it is taken away and how it is used. In the first of the two variants, "general tax decrease", all net changes in transport tax revenues are used to decrease general taxes outside the transport sector. 1 € of extra tax revenues collected from non commuting transport and used to decrease general taxes is given a value slightly higher than 1 for most countries. This means that this general tax decrease generates a small extra beneficial welfare effect. In the second variant "labour tax decrease", the change in transport tax revenues is used to decrease existing labour taxes. There is now a much stronger beneficial effect on the labour market, the value of the extra € ranges

between 1.26 and 2.52 depending on the national labour taxes. The reason is that taxes are shifted away from labour, directly alleviating the implied distortion of the labour market.

The aggregate results (EU-27+4) from Proost et al's work are summarised in Table 1 below.

It is useful to highlight four lessons that can be drawn from these results. Firstly, it is clearly very difficult to use the fuel tax as the only instrument to address all the externalities of cars and motorcycles. Scenario 1 shows that this requires enormous increases in fuel taxes, large increases in tax revenues (by a factor of 3) but only a tiny efficiency gain (if we rule out the pure effect of recycling the revenues to alleviate labour market distortions). Secondly, when a km charge for cars and trucks takes over as the main pricing instrument (scenario 2), revenues are double those in the reference scenario and welfare improves strongly – overall transport volumes decrease by some 11%. Thirdly, the benefits of finer spatial and temporal differentiation (scenario 3 compared to Scenario 2) give higher congestion relief benefits but generate less revenues – because of the large weight given to the increase in tax revenues, the result is that scenario 3 generates a smaller welfare gain than scenario 2 if taxes are equal to marginal external costs – if taxes could be optimised in both scenarios scenario 3 would produce clearly better results than scenario 2. Finally, it is well known that the introduction of a more refined (area and time based) charging and taxing regime increases a scheme's transaction costs (billing, enforcement etc.); this is not yet taken into account in the welfare computation and this needs to be checked region by region as a more refined pricing regime may only make sense in heavily congested areas.

Hence, it seems clear from the range of modelling exercises that the economic impacts of efficient pricing would, on the whole, be positive. Firstly, the revenues generated would be substantial and, depending on how the revenues are used, the overall result would be a significant increase in EU economic welfare. the gains in economic welfare arise both from the reduction of external costs and from an effective and efficient use of the extra

Table 1

In % of GDP	total revenues	Welfare change when general taxes are decreased	Welfare change when labour taxes are decreased	change in tonkm in % of reference	change in passkm in % of reference
Reference	2.298	0	0	0	0
scenario 1	6.224	0,034	1,706	–10,7	–17,4
scenario 2	5,402	1,191	2,725	–11,0	–11,5
scenario 3	5,391	1,181	2,702	–10,8	–11,2

Source: Made by the author.

revenues. Indeed, the way in which the revenues are used is generally shown to be vital for maximising the positive economic impact.

6. **CONCLUDING THOUGHTS**

As the European Commission embarks on a renewal of its Common Transport Policy for 2010 and beyond, efficient transport pricing continues to form a key plank of its efforts to develop and implement a 'sustainable' transport policy. In seeking to take forward the principle of 'internalising the external costs of transport', the policy is remarkably closely allied to conventional economic theory relating to social costs. Whilst it is clear that implementation requires a number of deviations from the 'pure' theory, it is clear – to the author at least – that the theory still forms a useful basis for policy and that the required deviations can be achieved in a way that minimises any efficiency-loss. That said, the Commission's initial plans for implementing the pricing reforms that flow from the adoption of the policy have been held up by a range of issues, in particular the difficulty in reaching agreement amongst the necessary stakeholders.

In fact, implementation of the policy has mainly focused on road and rail modes. For road, the emerging systems of charges for heavy goods vehicles offer the potential for charging which reflects the costs of road use much more accurately, by permitting a charge directly related to kilometres travelled, and which may be differentiated by vehicle type and, depending on the technology, in time and space. However, the current legislation – with its limits on maximum prices and its reference to infrastructure-related costs as a base - does not actually permit implementation of the Commission's policy of internalisation of external cost. Even the proposed revisions to the current legislation, fall short of full pursuit of this via the use of marginal cost based pricing. Thus, in many cases, road haulage falls some way short of paying marginal social cost. There is evidence that this, combined with high charges for rail freight, has a significant impact on freight mode split (e.g. Johnson et al, 2007)

For rail, Directive 2001/14 already requires charges based on direct cost, with provision for charging for all external costs when this is achieved on other modes, and mark-ups where needed for financial reasons. Whilst these form a sound set of principles, there is great diversity in the ways in which the directive has been interpreted, and a great variation in actual charges. In many cases rail infrastructure charges actually greatly exceed marginal social cost. There is strong indicative evidence that the resulting situation is damaging to the rail sector, and more generally to the transport system as a whole.

The clear evidence from studies of the impacts of implementing pricing reforms based on the Commission's stated policy is that, provided revenue is efficiently recycled, efficient charges will benefit the economies of most or all European countries. They will tend to benefit countries at the core more than at the periphery, leading to a possible argument for a mechanism for redistributing revenues between countries; but any such argument should be considered not in isolation but in the context of the EU's existing framework of financial redistribution between regions.

Whilst the Greening Transport and the Sustainable Future for Transport Communications contain laudable restatements of principles, they fall some way short of presenting systematic proposals to remedy the difficulties associated with current road and rail infrastructure pricing, or to accelerate progress with pricing reforms in ports and airports where there has been much less action thus far. On roads, action is needed to end the situation whereby infrastructure prices for heavy goods vehicles are permitted to be set below marginal social cost. Introduction of a simple, low-cost, EU-wide compulsory km based pricing system that varied with the characteristics of the vehicle, administered via the tachograph would be a major step in the right direction. Beyond this, removal of the arbitrary limits set within the Eurovignette directive – perhaps in a series of phases – would permit the more full implementation of the Commission's own policy. On railways, the variation in interpretation and approach to implementing Directive 2001/14 should be addressed as a priority, with the aim of reducing the cases where rail is charged significantly in excess of marginal social cost. The establishment of a set of common guidelines for implementing the Directive would again be a major step in the right direction. More broadly, consideration should also be given to re-opening discussions on the previously shelved proposal for a Framework Directive on infrastructure pricing for all modes. It is likely that the research and experience gained in the years since that Framework Directive proposal was shelved will have enhanced the chances of it making progress a second time around. Compatible reforms toward efficient pricing across all modes will, in the end, be the best means of securing the clear economic benefits that current pricing systems deny us.

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